

SPECIES RICHNESS OF FERNS AND ASSOCIATED INSECTS FROM DARJEELING PLAINS¹

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A survey in the Darjeeling plains revealed some eighteen species of ferns, of which, five were common. Insects found associated with the common ferns were mostly Hemiptera (20 spp.) and Coleoptera (19 spp.) followed by the Lepidoptera (12 spp.). Two polyphagous species of Orthoptera were recorded on the common ferns, *Diplazium* and *Christella*. Some microlepidoptera and thysanoptera were found associated with the sporophylls only. Besides a phytophagous species of sawfly, three other Hymenoptera recorded were parasitoids. The sole dipteran fly recorded was a larval-pupal parasite of the herbivorous lepidopteran, *Spilarctia scasigneta*. Some of the fern attacking insects also occur on economically important plants.

INTRODUCTION

Ferns are one of the most primitive plants are generally considered as difficult plants for herbivores to exploit (Eastop 1973, Hendrix 1977, Cooper-Driver 1978). As such, a relative paucity of insect-herbivores association with ferns has been reported (Schneider 1892, Brues 1920, Dethier 1947, Ehrlich and Raven 1964). Swezey (1922) reported an extensive insect fauna of 44 species associated with the fern flora of Hawaiian Islands. However, only one fourth of the insect species reported were actually phytophagous (Weiczorek 1973). This underutilization of ferns by insects has been attributed to host-resistant factors (Swain and Cooper-driver 1973, Huffaker 1974, Hendrix 1977, Balick *et al.* 1978, Daniel and Chandrasekar 1986). However, the extensively sampled fern *Pteridium aquilinum* (L) Kuhn, is known to support a fair population of insect fauna (Lawton 1976, strong and Levin 1979). Further a pioneering quantitative study by Balick *et al.* (1978), showed that three Mexican ferns were also extensively exploited by insects.

The phytogeographic area of Darjeeling plains has a heterogenous vegetation. The forest, agroecosystem, tea gardens are either flanked by or

interspersed with fern vegetation. It is likely that some of the fern associated insects may switch over to such economically important vegetation. On the other hand, the possibility of the adjacent fern flora harbouring the natural enemies of the crop-pests also cannot be overlooked. Therefore with an eye to the nature of contribution that the fern vegetation makes through insect-fern-crop interaction and also to examine the hitherto unknown insect faunal community of common ferns the present investigation was undertaken.

MATERIALS AND METHODS

A monthly survey was done during 1988-90 at different sites, and the fronds were randomly sampled. The insects associated with the fronds of the common ferns were either hand picked or collected with the help of an aspirator. They were later etherised and oven dried before preservation for identification. The spotulating fronds were collected and brought to the laboratory where they were poisoned and pressed for herbarium preparation.

In case of the insect eggs and larvae, the ferns on which they were found were supplied as food to rear them to the adult stage. The ferns as well as the insect materials were identified by the Botanical Survey of India, Zoological Survey of India and by other competent authorities.

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OBSERVATIONS AND RESULTS

The survey of fern flora and the associated insects of the common ferns was conducted extensively in the Darjeeling plains that was delimited by river Teesta in the east and river Mechi in the West. The ferns so far recorded are listed in Table 1. Of these the commonly found ferns belong to the genera *Diplazium*, *Christella*, *Lindsea* and *Microlepia*. The insects associated with these common ferns were specially considered and identified to understand their role in the insect-fern-crop relationship. Of these groups of ferns, *Diplazium* had the largest number of insect herbivores, followed by *Christella* and *Microlepia* (Table 2). *Lindsea* was abundant but no insect, attacking this fern, could be recorded. Some specialized feeders like some microlepidoptera were found to exploit the spores and sporangiophores of *Christella* and *Diplazium*. Most of the lepidoptera larvae, including the economically important species, used maturing fronds as food. *Psara ustulalis*, however, had the peculiarity of rolling the apex of the mature fronds to make its own nest, where it ultimately pupated. While almost all the immature stages of the polyphagous species, *Spilarctia casigneta* was commonly recorded on *Diplazium*, natural occurrence of *S. obliqua* was more sporadic on the same host plant.

Of the commonly occurring beetles, worth mentioning was the green weevil, *Astycus lateralis*, which nibbled the maturing fronds and were also known to attack tea. Another polyphagous weevil, *Mylocerus disolour*, was common and had the potentiality to attack a number of crops (Table 3).

Colonies of two species of aphids belonging to different genera were restricted to the ventral side of the young and maturing fronds of *Diplazium*. Two distinct species of mirids were found to be more associated with *Christella* than with *Diplazium*, and unlike most other insects they attached the young coiled fronds. Amongst the hymenopterans found associated as a true herbivore, a species of sawfly, *Stromboceros congener*, needs special mention. All

the larval stages of the species used maturing fronds of *Diplazium* and *Christella* as their food. Pupation took place in soil. The larvae of the species of thrips (mentioned in Table 2) were found associated with the sporophylls of *Diplazium*.

The natural enemies of the fern insects were mainly parasitoids. The brachonid parasitoids were recorded from the larvae, while the chalcids were recorded from the eggs of *S. casigneta*. The larvae of *S. casigneta* were found to be attacked by larval-pupal parasitoids. These were the uzi flies possibly belonging to the genus *Exorista*. The larvae of these lepidopterans when reared indoor were also affected by a fair infestation of these tachynid flies. The heteropteran bug, *Eusarcocoris ventralis*, was found to attack the lepidopteran larvae of *P. ustulalis*.

DISCUSSIONS

The list of fern flora and its associated insect fauna is based on survey work using the methods of random sampling at spots selected across the entire stretch of the Darjeeling plains. Although utmost care had been taken to record the available species of ferns and the insects associated mostly with the common ferns, yet the list may not be complete. The chances of finding new fern species and their associated insect forms can not be ruled out in the elephant infested stretch of Terai woodlands and amongst the epiphytic ferns. Moreover, some of the insect species occurring for very short periods and also those which are facultative fern-feeders, might have gone unnoticed.

Examination of the British fern-feeding insects (Ottosson and Anderson 1983) and comparison with a more comprehensive list by Hendrix (1980) revealed that the present list of the fern-associated insects of Darjeeling plains had most of the orders in common excepting for Collembola and the phytophagous Diptera. The finding of thysanoptera from the fern fauna of Nilgiri and Annamalai hills by Daniel and Chandrasekar (1986) was corroborated by the present observation from this part of India, when the association of thrips were also recorded with the

TABLE 1
A LIST OF FERNS FROM DARJEELING PLAINS

1. *Blechnum orientale* Linn.
2. *Christella appendiculata* (Pr.) Holt.
3. *Christella aridus* (Holt).*
4. *Christella crinipes* (HK) Holt.*
5. *Christella parasiticus* (L) Lev.
6. *Cyathea spinulosa* Wall Hook. (Tree Fern)
7. *Diplazium esculentum* (Retg) Sw.*
8. *Dicranopteris linearis* (Brum. f.) underus.*
9. *Lindsea ensifolia* Sw.*
10. *Lygodium flexuosum* (L) Sw.
11. *Macrothelypteris torresiane* (Gaud) Ching
12. *Microlepia speluncae* (L) Moore*
13. *Onichium siliculosum* (Desv.) C. Chn.
14. *Pityrogramma calomelanos* (Linn.) Linx.
15. *Pteris semipinnate* Linn.
16. *Pteris laiaurita* Linn.
17. *Pteris vittata* Linn.
18. *Lypteris* sp.

* Commonly occurring fern species.

TABLE 2
A SPECIES LIST OF INSECTS ASSOCIATED WITH FERNS
FROM DARJEELING PLAINS

Insect name and Order	Family
LEPIDOPTERA	
1. <i>Callopietria placododoides</i> (Guen)	Noctuidae
2. <i>Prodenia litura</i> (Fabr)	"
3. <i>Spodoptera mauritia</i> (Boisd)	"
4. <i>Eriopus</i> sp.	"
5. <i>Spilarctia casigneta</i> (koll.)	Arctiidae
6. <i>Spilarctia obliqua</i> (Walak.)	"
7. <i>Spilosoma</i> sp.	"
8. <i>Diacrisia punctata</i> (Moore)	"
9. <i>Nacoleia vulgaris</i> (Hampson)	Pyalidae
10. <i>Psara ustulalis</i> (Hampson)	"
11. <i>Amata cyssea</i> (Cramer)	Ctenuchidae
12. Microlepidopteran sp. (indet)	
COLEOPTERA	
1. <i>Anthicus</i> sp.	Anthicidae
2. <i>Aphaniptera</i> sp.	Buprestidae
3. <i>Chrysolina inconstans</i> Wied	Chrysomelidae
4. <i>Aspidomorpha dorsata</i> (F.)	"
5. <i>Aspidomorpha nr. indica</i> Boh.	"
6. <i>Aspidomorpha sanctaerueis</i> (F.)	"
7. <i>Hoplasoma unicolour</i> (Lu.)	"

8. *Manobia* sp.
 9. *Monolepta* sp.
 10. *Altica* sp.
 11. *Afissa dumeili* (Muls.)
 12. *Cryptogonus* sp.
 13. *Nanophyes* sp.
 14. *Alcides* sp.
 15. *Astycus lateralis* (F.)
 16. *Myllocerus discolour* (Boh)
 17. *Phytoscapus* sp.
 18. *Legria* sp.
 19. Species (indet)
- Coccinellidae
Curculionidae
"
"
"
"
Lagridae
Elateridae

HEMIPTERA

1. *Macromyzus* sp.
 2. *Tinocallis* sp.
 3. *Clovina conifera* (Walk)
 4. *Typhlocyba* sp.
 5. *Bathrogonia ferruginea* Fabr.
 6. *Penthimia juno* Dist.
 7. *Gargara robusta* (Dist.)
 8. *Homoeocerus* sp.
 9. *Cletus bipunctatus* Westw.
 10. *Leptocoris acuta* (Thunb.)
 11. *Graptostethus trisignatus* Dist.
 12. *Spilostethus pandurus* (Fabr)
 13. *Agonoscelis nubila* Fabr.
 14. *Erthesina guttata* (Fabr)
 15. *Eusarcocoris ventralis* Westw.
 16. *Dysdercus koenigii* (Fabr)
 17. *Iphita limbata* Stal.
 18. *Chrysocoris stollii* (Wolff.)
 19. Species A (indet)
 20. Species B (indet)
- Aphididae
"
Cercopidae
Cicadellidae
"
"
Membracidae
Coreidae
"
"
Lygaeidae
"
Pentatomidae
"
"
Pyrrhocoridae
"
Scutellenidae
Miridae
"

HYMENOPTERA

1. *Stromboceros congener* knw.
 2. *Apanteles* sp.
 3. Species A (indet)
 4. Species B (indet)
- Tenthridinidae
Braconidae
Ichneumonidae
Chalcidae

ORTHOPTERA

1. *Atractomorpha crenulata* (Fabr.)
 2. *Phlaeoba panteli* (Bolivar)
- Pyrgomorphidae
Acrididae

THYSANOPTERA

1. *Heliothrips haemorrhoidalis* (Bouche)
 2. *Elaphrothrips* sp.
- Thripidae
Phlaeothripidae

DIPTERA

1. *Exorista* (?)
- Tachynidae

TABLE 3

FERN ASSOCIATED INSECT SPECIES ATTACKING CROPS

[List prepared after Nair (1975), Das (1965),
Banerjee and Haque (1985) and local observations]

Order and Insect Name	Alternate Host Plants
LEPIDOPTERA	
<i>Spilarctia casigneta</i> (Koll)	Black gram, sunflower, Sunhemp.
<i>Spilarctia obliqua</i> (Walk)	Jute, sesamum, castor, ladies finger, groundnut, linseed, turmeric, sunflower, sunhemp, potato, sweet potato.
<i>Spodoptera mauritia</i> (Boisd)	Rice, wheat foliage, millets.
HEMIPTERA	
<i>Agonoselis nubila</i> Fabr.	Rice, wheat, millets. pulses, ber, tobacco.
<i>Chrysocoris stollii</i> (Wolff.)	Leechi.
<i>Eusarcocoris ventralis</i> Westw.	Sesamum.
COLEOPTERA	
<i>Astycus lateralis</i> (F.)	Tea, millets, jute, cotton, sunhemp.
<i>Mylocerus discolour</i> (Boh.)	Drumstick, rice, wheat, millet, cotton, groundnut.
ORTHOPTERA	
<i>Atractomorpha crenulata</i> (Fabr.)	Tobacco, sunflower, jute.
THYSANOPTERA	
<i>Heliothrips haemorrhoidalis</i> (Bouche)	Citrus, tea, coffee.

sporophylls of *Diplazium*. However, most of the representative species of the insect-fauna of fern observed in the present survey seemed to be restricted to the Oriental region as they had little in common with the comprehensive list comprising the elements from other parts of the world (Hendrix 1980).

The study of the insect fauna of ferns is also of economic significance, because a number of these species being polyphagous have the potentiality to switch over and cause damage to crop plants. They may also contribute in terms of natural insect enemies, that may keep the crop-pest population under control (Ananthakrishnan *et al.* 1986). It is only after the correct identification that the role of the Uzi flies can be understood. If the flies do not attack silk-worm larvae they may be useful as a natural controlling agent of lepidopteran pests.

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